

ISSUES IN E-LEARNING STANDARDS

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ABSTRACT

This paper will discuss the role of e-learning standards for implementing e-learning applications. We briefly define and describe the issues related to e-learning standards to improve performance and availability of e-learning content. We also describe the characteristics of standards important for maintaining high quality e-learning contents. The various standards are analyzed and the degree of synergy between different standards organizations is identified. We discuss the life cycle for e-learning standards, and the main types of standards to enable the interchange of components in a learning system. The Malaysian experience is presented as a case study.

Key words: Digital data, e-learning, standards, performance, high availability, quality.

INTRODUCTION

Successful companies select a few standards and enforce them strictly (Gates, 1995). As the need for digital data becomes more ubiquitous, so does the need to provide efficient mechanisms for distributing data designed according to e-learning standards. The so-called standards are Aviation Industry CBT Committee (AICC), Instructional Management System (IMS), Advanced Distributed Learning (ADL), Institute of Electrical and Electronics Engineers (IEEE), Learning Resource iNterchange (LRN), and Sharable Courseware Object Reference Model (SCORM). In reality, SCORM is not a standard but a reference model for a suite of standards developed by other bodies. Usually, the content is loaded in the learner's Web browser, and the Learning Management System (LMS) resides on a remote server. Unless the content and the LMS use the same language, syntax and vocabulary, they will not be able to communicate. Standards also give assurance to buyers about interoperability, the ability of the system or product to work with other systems or products without special effort on the part of the customer. All contents that conform to an e-learning standard will run equally well on all LMSs that conform to the same standard (Morrison, 2003).

To understand the passion for e-learning standards, one needs to understand the underlying problems that necessitate the development of these standards. The learners cannot easily find the course they need. Course authors find it difficult to combine content and tools from different vendors. Course administrators cannot move courses, each with hundreds of files, from system to system. Learners with disabilities need custom-developed courses and can only communicate with the systems on which these courses were

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developed. Organizations are addressing these problems in several ways. They are developing standards that promote building e-learning from reusable parts and that help reduce dependence on individual vendors and products. One of the explicit goals of standards is to allow the reuse of content at all levels: not just whole courses and online materials, but smaller units as well (Horton and Kendall, 2003).

All standards have a development life cycle comprising a series of highly iterative and time-consuming processes. It is possible that e-learning may embrace a de facto standard, though to date there has been no universal standard. The specifications, guidelines and recommendations are not standards unless a large number of people follow them.

ISSUES

There are several issues that need to be considered to decide when and how to integrate standards into e-learning content.

Project

*Which standards apply to your project?

Standards that apply to the administrative systems LMSs and LCMSs (Learning Content Management Systems) are basically the same as those for courseware: interoperability and content package standards. The main purpose of these standards is the integration of courseware and administrative systems. The same specifications that are relevant for courseware also apply to administrative systems. The standards are AICC and SCORM Run-Time Environment.

Product

*Which standards can add value to the finished product?

The AICC CMI (Computer-Managed Institution) specification and the SCORM Run-Time Environment specification contain a data model. The SCORM version 1.2 data model is based on the AICC CMI specification data model but has a reduced set of optional data items and adds value to a product by using the AICC CMI specification. An LMS that offers tracking for any of them is required to implement them in conformance with the specifications. The LMS supports a particular optional data element and then takes the appropriate action based on the element's availability.

Workflow

*Which standards can make workflow more efficient?

The workflow process follows requirement, analysis and design, implementation, test, and deployment. In the analysis and design stage the contents must follow specifications which should increase the efficiency of the workflow. The standards are SCORM and AICC.

Reuse of Components

*Which standards allow reusability of components?

The most important characteristic of LOs (Learning Objects) is that they are designed to be reused in different contexts. LOs can be used in many composite learning components. To enable sharing and reusability, each LO needs a descriptive “packaging.” This packaging provides information such as a description of the contents of the LO, its identifier, the learning objectives it meets, its builder and the target location. It helps to locate an LO as a particular product. The learning content is the product. It is enclosed in a package on which its name and other details are printed. This information must be provided in a standard and universally understood format. This problem is solved by the use of metadata (data about data). Standards exist for two different models that describe the way in which courses are constructed from LOs. One model forms part of the SCORM. The other model was developed by the AICC (Fallon and Brown, 2000).

Applications

*How are standards incorporated into one’s work?

First, it is necessary to identify the area of application for content design. Then the proper specification is selected for content packing in a particular application.

*Are standards really worth the trouble?

The reaction of some designers to the pitfalls in the standards’ life cycle is to ignore standards altogether until they become accredited. The designers feel that the specifications that exist today are not stable. It is certainly true that standards will develop further and change over time. The adoption of AICC certification, AICC conformance, and SCORM conformance by many major e-learning vendors is a good indication of how important the vendors feel about standards.

The standards organizations want vendors, developers and designers to continue to adhere to their specifications. This gives them the incentive to make transitioning from old to new versions of specifications as easy as possible. Suppose that you follow one of today’s standards for e-learning components that you purchase or develop and that by the time the standard becomes accredited, 30% of it has changed. In this scenario, your e-learning component will still be 70% compliant with the appropriate accredited standards. However, if you ignore today’s standards, your components may be 0% compliant when the standards become accredited (Fallon and Brown, 2000).

Identification

*Should one purchase tools that comply with standards or that make compliance easier?

Yes, this would reduce the learning curve and help to achieve smooth development of software.

*Which standard should one follow first?

SCORM. As per a survey undertaken in Malaysia, many projects are designed using SCORM (Aisrvatham, 2003). The reasons why SCORM is followed are:

- a) SCORM has the following features: reusability, interoperability, ability to reduce development time and cost, and ability to increase quality of content.
- b) SCORM consists of overview, content aggregation and run-time environment.

*Who can guarantee compliance?

The developer can guarantee compliance of standards for his/her products because the developer complies with standards in designing the contents.

*Would one build standards into the template and scripts that one uses in constructing the content?

Yes. The templates are useful for developers or designers of content. Building in the standards further reduces complications and improves efficiency in constructing the content.

CHARACTERISTICS

The development of e-learning standards to design and deliver e-learning content is summarized as “DAMRAIN”—which stands for Durability, Accessibility, Manageability, Reusability, Affordability, and INTERoperability.

Durability

The LMS and LCMS must be able to accommodate minor changes to the contents and to the application design without the need to redesign the e-learning system. Even if there are major changes to the contents, the standards should enable the design of the e-learning system to be consistent.

Accessibility

The LMS or LCMS must have the ability to access courses and learning objects through the use of metadata and package standards, thereby allowing many learners to access learning content stored remotely.

The metadata access specification is intended to make it possible to identify resources that match a user’s stated preferences or needs. These preferences or needs would be declared using the IMS LIP (Learner Information Package). The needs and preferences addressed include alternative presentations of resources, alternative methods of controlling resources, alternative equivalents to the resources themselves, and enhancements or support required by the user. The specification provides a common language to identify and describe the primary or default resource and equivalent alternatives for that resource.

Manageability

Manageability is the ability to track the learner's use of the e-learning system and the storage of the resulting data in an LMS or LCMS as a learning record accessible by both the learner and management. The system should be able to package the learning objects so that they can be managed for a large number of users.

Reusability

Reusability is the ability to design, store and manage learning content as small compatible learning objects that can be used in combination over and over again as elements of different courses. A curriculum is assembled from reusable courses, which are assembled from reusable lessons, which are made of reusable pages containing reusable media elements. These units are called reusable learning objects or sharable content objects. The designer can reuse all components many times (Horton and Kendall, 2003).

Affordability

Affordability is to leverage standardized technologies to increase development productivity and learning effectiveness while reducing cost (Fallon and Brown, 2000). If standards are followed, integration with various software tools that follow the same standards will be cheaper in both personnel and software cost. This will allow future development to be done in piecemeal mode, reducing cost and making the development more effective. Affordability is not only seen in monetary form but also in the best use of creative energy and time.

Interoperability

Interoperability allows the picking of the best designer, tools, content, and management systems—and enables the replacement of any of them without having to redo the others. All features and functions of content that conform to a standard can be used on any LMS that conforms to the same standard. It is then possible to have content authored by different vendors, using different authoring tools, running on the same LMS and exploiting all the content features and functions; also, data can be shared between enterprise systems without intervention (Morrison, 2003). The existing specifications that deal with courseware interoperability are the following:

- AICC AGR 010, which references the AICC CMI specification.
- SCORM Run-Time Environment.

Figure 1 describes interoperability. The designers X and Y use certain tools to produce learning objects that are self-contained, reusable modules of a project. The learning management system can assemble a course by integrating these separate objects developed by different designers using different tools (Horton and Kendall, 2003).

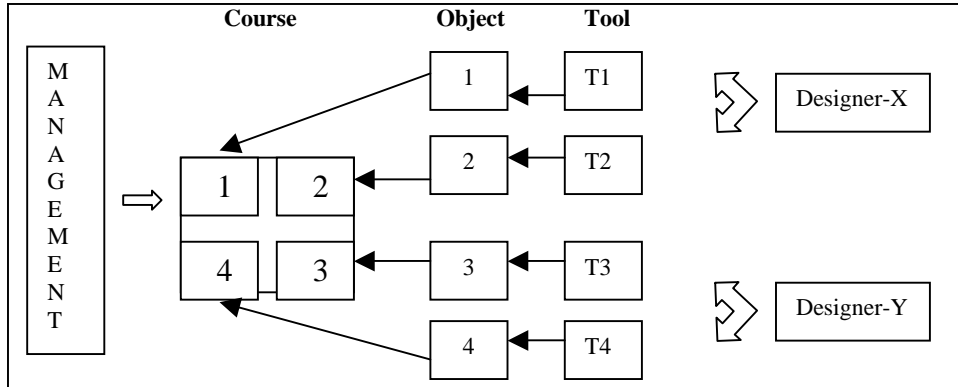


Figure 1. Interoperability

STANDARDS ORGANIZATIONS

Aviation Industry CBT Committee (AICC)

AICC was one of the first bodies to publish specifications for tracking and interoperability, and their work was adopted by businesses outside the aviation industry. For years, AICC specifications were the de facto e-learning standard. When vendors claim their products are “AICC-compliant,” they actually mean that they have implemented some of the nine AICC guidelines. Since different vendors can implement different guidelines, AICC compliance does not ensure interoperability. The AICC content hierarchy also has three components:

- Course: The top level of the hierarchy, at which content is assigned to learners.
- Instructional block: An optional intermediate grouping of smaller learning units. Instructional blocks can be nested inside one another to provide any number of levels.
- Assignable unit: The AICC’s learning object (Fallon and Brown, 2000).

Advanced Distributed Learning (ADL)

This technology focuses on the following:

- Technology to deliver learning at a faster rate and at a lower cost.
- Standardization to enable interoperability.
- Learning objects to enable searchable and reusable content.

ADL’s strategy provides a focus for standards bodies by harmonizing their efforts in a reference model called SCORM (Sharable Content Objects Reference Model). ADL provides both a forum and a technology test bed for the integration of specifications. ADL likes to think of SCORM as a super class, which treats each separate draft specification as a

separate class. Figure 2 shows how different standards groups have contributed to the reference model.

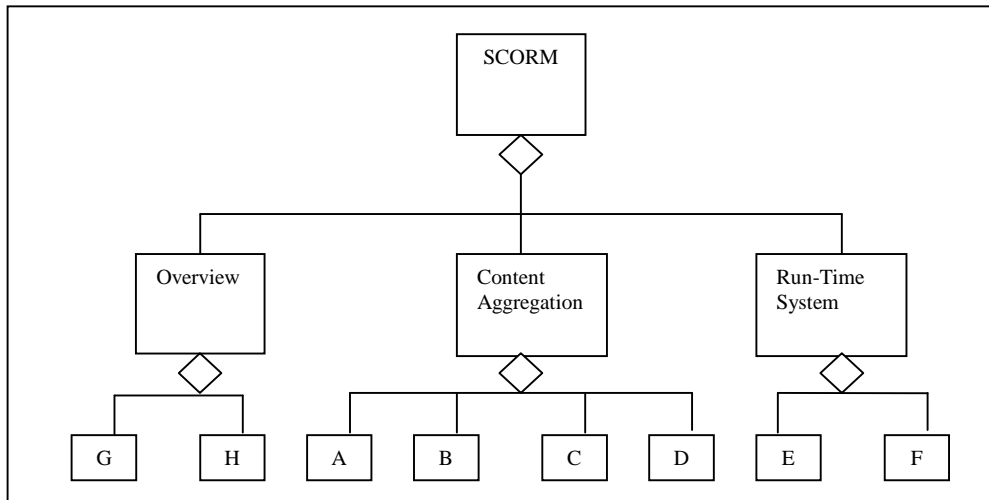


Figure 2. The SCORM Overview

- | | |
|------------------------------------|------------------------------------|
| A: Metadata dictionary (from IEEE) | B: Content packaging (from IMS) |
| C: Content structure (from AICC) | D: Metadata XML binding (from IMS) |
| E: Data model (from AICC) | F: Communication API (from AICC) |
| G: Technical specifications | H: Guidelines |

The model consists of three classes. SCORM is a “Super class” containing subclass-1, which includes an overview of the ADL initiative, the rationale for the SCORM and a summary of the technical specifications and guidelines contained in the remaining sections. Subclass-2 (The SCORM Content Aggregation Model) contains guidance for identifying and aggregating resources into structured learning content. Subclass-3 (The SCORM Run-Time Environment) includes guidance for launching, communicating with, and tracking content in a Web-based environment (Morrison, 2003).

SCORM assumes the existence of a suite of services called by either an LMS or an LCMS. Most Web documents consist of hyperlinks from one page to another. In SCORM the LMS, the main element, knows what is to be delivered to the learner. SCORM standardizes how to start and track directed learning, and the behavior and logic of complex learning, so that content can be reused, moved, searched for and reassembled. SCORM supports e-learning that enables interoperability, accessibility and reusability of e-learning content. SCORM continues to update and expand the scope of the specification. The SCORM content hierarchy includes three types of components shown in Figure 3.

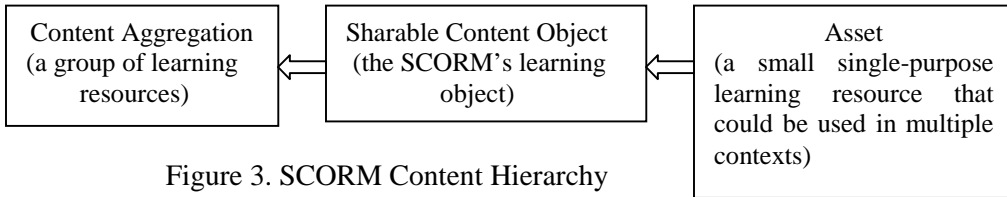


Figure 3. SCORM Content Hierarchy

ARIADNE

ARIADNE (Alliance of Remote Instructional Authoring Distribution Networks for Europe) was one of the pioneers in developing specifications for e-learning metadata and reusability. It describes its goals thus: “The project focuses on the development of tools and methodologies for producing, managing and reusing computer-based pedagogical elements and telematics-supported training curricula. Validation of the project’s concept is currently taking place in various academic and corporate sites across Europe” (Morrison, 2003).

Institute of Electrical and Electronics Engineers (IEEE)

The IEEE is the leading authority in technical areas. It is involved in e-learning standards through its Learning Technology Standards Committee (LTSC) whose mandate is to develop accredited technical standards, recommend practices, and guides for learning technology. The LTSC provides independent evaluation of draft specifications developed by bodies like AICC and IMS, with the ultimate aim of certifying a specification, followed by publishing it as a new standard. The IEEE LOM (Learning Object Metadata) standard specifies the syntax and semantics of LOM required to fully and effectively describe a learning object. The main focus area is on the development, deployment, maintenance, and interoperation of e-learning components and systems. The IEEE/LTSC LOM specification was derived from work done by the IMS and ARIADNE. This specification, which forms the basis of the current IMS Learning Resource Metadata Information model, is included in SCORM. Ultimately, most of the standards developed by IEEE/LTSC will be advanced as an International Organization for Standardization (ISO) standard.

Instructional Management System (IMS)

IMS produces open specifications for locating and using e-learning content, tracking learner progress, reporting learner performance, and exchanging records between administrative systems such as LMSs. IMS specifications that have been adapted for use in SCORM version 1.2 are the following:

- The IMS Learning Resources Metadata Specification (LRMDS) defines a method for describing learning resources so that they can be located using metadata-aware search software.

- The IMS Content & Packaging Specification (CPS) defines how to create reusable LOs that can be accessed by administrative systems such as LMSs and LCMSs.
- The IMS Question & Test Interoperability Specification (QTIS) addresses the need to be able to share test items and other assessment data across different administrative and assessment systems.
- The IMS Learner Profiles Specification (LPS) defines ways to organize learner information so that administrative systems such as LMSs and LCMSs can be more responsive to the specific needs of each user.
- The IMS Simple Sequencing Specification (SSS) defines a method for specifying adaptive rules that govern the sequence in which reusable LOs are to be presented to the learner (Fallon and Brown, 2000).

IMS has been a pioneer in e-learning standards. It makes contributions in the areas of metadata and content packaging. The IMS metadata standards are firmly rooted in modern Internet technologies such as XML. The main purpose of these specifications is to provide comprehensive standards relating to content structuring.

Learning Resource iNterchange (LRN)

LRN is a commercial implementation by Microsoft of some e-learning specifications. Specifically, LRN supports the IMS Content Packaging d1.1 and Metadata 1.2 specifications; it also supports the SCORM 1.2 reference model.

RELATIONSHIPS

The IMS Learning Resources Metadata Information Model used in the SCORM was based on work done by both IMS and ARIADNE. The SCORM Run-time Environment includes the API (Application Programming Interface) developed by ADL and the AICC. Although each organization focuses on its own area, they are all working toward the common goal of attaining a set of internationally accredited standards for e-learning. The degree of synergy among these standards organizations is manifested by the fact that many of the individuals who participate in the various committees and working groups do so within two or more of the standards organizations simultaneously (Fallon and Brown, 2000).

STANDARDS LIFECYCLE

All standards have a development lifecycle comprising a series of highly iterative and time-consuming modules. The lifecycle starts with project needs and research and development concepts. By exposing these notions to interested consortia, draft specifications can be developed. When there is consensus about the specifications, they are tested in laboratories and test beds to see whether the theory works in practice. Draft specifications should also be exposed to the market. Once there is evidence that the agreed specification works, the test

results, in the form of a reference model are sent to a standards organization for third-party validation, followed by accreditation. Once a standard has been accredited, a global standards organization like ISO can promote it to an approved international standard (Morrison, 2003).

QUALITY ASSURANCE STANDARDS

Quality assurance concerns the design and quality of digital content from the viewpoints of subject matter and instructional design. Quality assurance ensures that e-learning content has certain characteristics or was created using certain established processes. E-learning technology is sufficient to ensure a free exchange of reusable learning objects. Quality standards ensure that objects are not only reusable but usable in the right place. Quality assurance standards can help customers select the right products. The availability of e-learning content from the customer's perspective is assessed by the lessons, course details and exams, which must be designed in compliance with universal standards.

THE MALAYSIAN EXPERIENCE

In 2003, the Malaysian scenario indicated that compliance with SCORM specifications by educational institutions was approximately 54% (Aisrvatham, 2004). Another survey conducted in 2004 by Multimedia University indicated that the percentage of educational institutions using SCORM-based content was 64% (Aisrvatham, 2004). Thus, it is clear that SCORM is gaining popularity in Malaysia as the e-learning standard. The Malaysian Institute of Microelectronic Systems (MIMOS) is preparing e-learning standards for Malaysia. These specifications will be implemented in the near future as the Malaysian Grid for Learning (MyGfL). One of the objectives is to develop e-learning standards to ensure conformance to and adoption of best practices in learning content and systems. INTAN (Institut Tadbiran Awam Negara or Institute of National Public Administration) also follows SCORM specifications for the implementation of e-learning for all government employees. The pilot implementation is expected to be completed in March 2005 (Aisrvatham, 2004). The Asian E-Learning Network (AEN), which comprises 13 countries and is based in Japan, has agreed to adopt SCORM specifications. Malaysia is part of this network.

CONCLUSION

The e-learning market will continue to develop rapidly, especially in content design. There are several standards available but not many have adopted these specifications. This paper has provided guidelines for users to select the standards for their e-learning solutions.

It is pertinent that the issues discussed be carefully considered. Furthermore, these issues need to be analyzed and solutions found. Market forces should not be ignored. The importance of e-learning standards in the implementation of an e-learning solution is vital for long-term success and to optimize cost.

Most of the respondents to the survey conducted in Malaysia (Aisrvatham, 2004) favoured SCORM over the other standards, with respect to most of the criteria and characteristics. It is clear that SCORM has taken into account other specifications such as IMS, IEEE LTSC, and AICC. Different standards organizations have different focus areas, thus comparison will be difficult. Today's e-learning market favours SCORM. Thus SCORM will have a greater chance to be adopted as the international specifications for e-learning.

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